

Vaccine-Preventable Diseases in Colorado's Children - 2011

Carl Armon PhD, James Gaensbauer MD, James Todd MD

Vaccines have been highly effective and very safe in Colorado and have had a dramatic effect on reducing vaccine-preventable diseases (VPD). Colorado has made substantial progress over the last decade in vaccinating its children but still has not achieved the national goal of a 90% vaccination rate, with a drop-off in vaccination rates in 2009-2010. Especially concerning is a lack of timely vaccination in our youngest children. Although regulations require most vaccines by the time a child enters school, the greatest risk for many of these diseases is still in children under two years of age. Colorado children with Medicaid, State Children's Health Insurance Plan (SCHIP), or no insurance are twice as likely to get a VPD as children with private insurance. For pertussis, varicella, influenza, viral gastroenteritis, *Streptococcus pneumoniae*, and *Haemophilus influenzae*, there were still over \$27 million in hospital charges for severe disease associated with these infections in Colorado children in 2010, with significant impact in both the public and private sectors. SHCC 2012; VIII:1, 1-6

■ Introduction

The Centers for Disease Control and Prevention (CDC) ranks vaccination as one of the top ten most effective public health measures in the last 100 years. To assure the maximum benefit of this most important preventive health resource, the national Childhood Immunization Initiative goal, as set in 1993, was "by 2000, [to] ensure that at least 90 percent of all two-year-olds receive the recommended series of vaccinations, and that a system is in place to sustain high immunization coverage." In 2002 and 2003 National Immunization Surveys (NIS) ranked Colorado among the worst of 50 states in overall childhood vaccination rates. While there has been significant improvement in the last several years, our state has yet to achieve the desired 90% vaccination rate for most vaccines. This annual analysis of Colorado data is undertaken to evaluate the progress and opportunities that exist in preventing vaccine-preventable diseases (VPD) for Colorado's children.

■ Summary of Methods

The data sources and methods are summarized in previous yearly reports (*Vaccine-Preventable Diseases in Colorado's Children, 2003; 2004*) and updated annually using the most recent data available (2010) from NIS, Colorado Hospital Association (CHA) and the Colorado Department of Health and Environment (CDPHE).

■ Results

The National Immunization Survey (NIS) shows Colorado has improved its vaccination rate since 2002-2003 but has regressed somewhat in 2009 and 2010. As shown in **Figure 1**, the American Academy of Pediatrics 2012 Immunization Schedule recommends that by 19-35 months of age, children should have received, among others, the following vaccine doses: 4 diphtheria, pertussis, tetanus (DTaP); 3 polio; 1 measles, mumps, rubella (MMR); 3 *Haemophilus influenzae* (Hib) [4 Hib beginning in 2009]; 3 hepatitis B and 1 varicella vaccination (referred to collectively as "431331"). Additionally, infants should receive vaccination against two further diseases included in this report: rotavirus in the first year of life, and for influenza yearly starting as early as 6 months.

<http://aapredbook.aappublications.org/resources/IZSchedule0-6yrs.pdf>

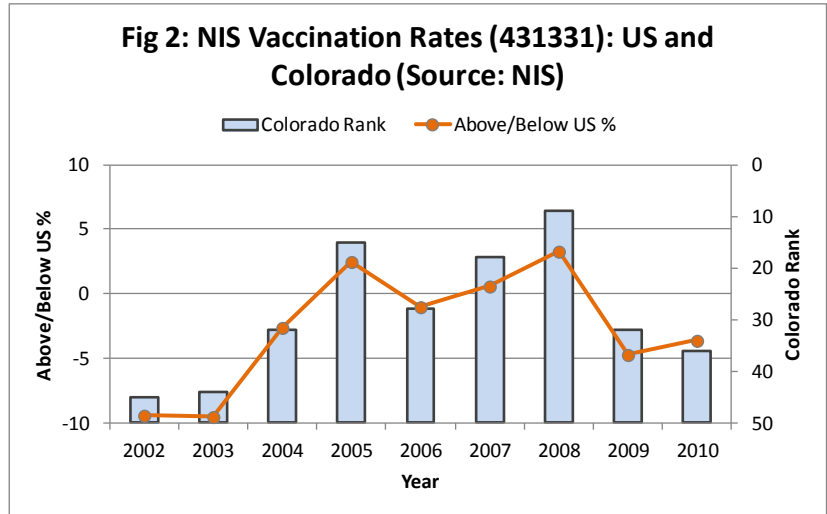
FIGURE 1. Recommended immunization schedule for persons aged 0 through 6 years — United States, 2012 (for those who fall behind or start late, see the catch-up schedule [Figure 3])

Vaccine ▼	Age ►	Birth	1 month	2 months	4 months	6 months	9 months	12 months	15 months	18 months	19-23 months	2-3 years	4-6 years	
Hepatitis B ¹	HepB		HepB					HepB						Range of recommended ages for all children
Rotavirus ²			RV	RV		RV ²								
Diphtheria, tetanus, pertussis ³			DTaP	DTaP	DTaP		See footnote ³		DTaP				DTaP	
<i>Haemophilus influenzae</i> type b ⁴			Hib	Hib	Hib			Hib						Range of recommended ages for certain high-risk groups
Pneumococcal ⁵			PCV	PCV	PCV			PCV					PPSV	
Inactivated poliovirus ⁶			IPV	IPV				IPV					IPV	
Influenza ⁷								Influenza (yearly)						
Measles, mumps, rubella ⁸								MMR		See footnote ⁸			MMR	Range of recommended ages for all children and certain high-risk groups
Varicella ⁹								VAR		See footnote ⁹			VAR	
Hepatitis A ¹⁰								Dose 1 ¹⁰					HepA series	
Meningococcal ¹¹								MCV4 — See footnote ¹¹						

This schedule includes recommendations in effect as of December 23, 2011. Any dose not administered at the recommended age should be administered at a subsequent visit, when indicated and feasible. The use of a combination vaccine generally is preferred over separate injections of its equivalent component vaccines. Vaccination providers should consult the relevant Advisory Committee on Immunization Practices (ACIP) statement for detailed recommendations, available online at <http://www.cdc.gov/vaccines/pubs/acip-list.htm>. Clinically significant adverse events that follow vaccination should be reported to the Vaccine Adverse Event Reporting System (VAERS) online (<http://www.vaers.hhs.gov>) or by telephone (800-822-7967).

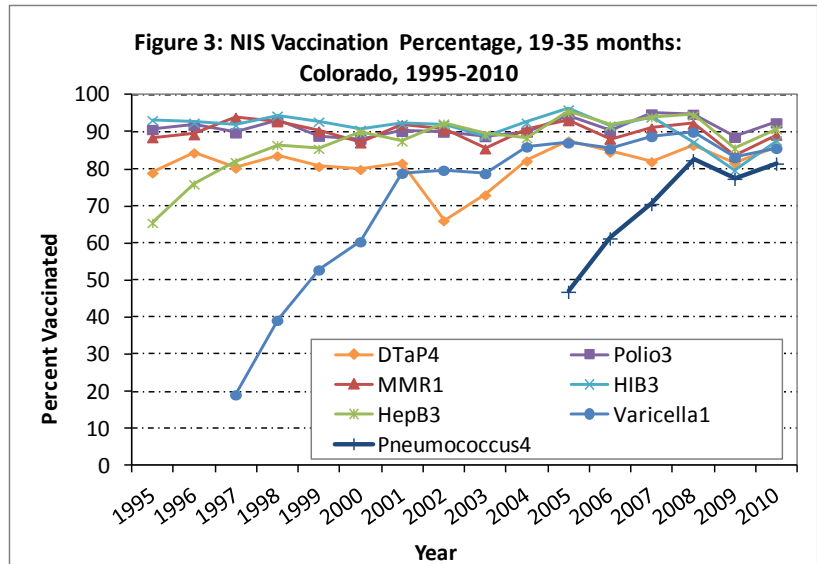
Colorado Vaccination Rates and Ranks Fluctuate

As shown in **Figure 2**, Colorado steadily improved on its initially low 431331 national vaccination rank in 2002-2003, exceeding the national average from 2005 to 2008 but falling below it again in 2009 and 2010.



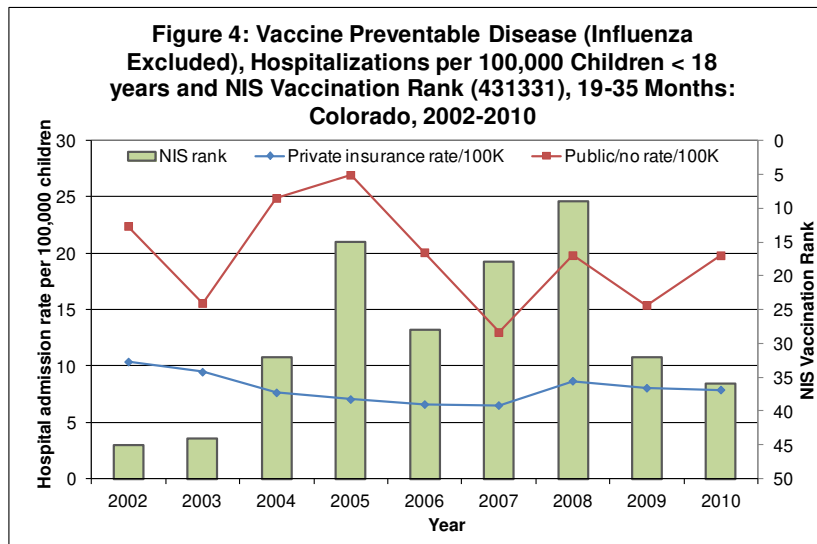
Individual Vaccination Rates Are Below 90% for Most Vaccines

Figure 3 suggests that new vaccines are gradually accepted over approximately five years but it has been difficult to achieve and/or sustain a 90% threshold for most vaccines. Vaccination rates had fallen off for most vaccines in 2009 with partial recovery in 2010. Currently, few vaccines exceed the 90% vaccination rate goal and the aggregate 431331 rate is only 71.3%.



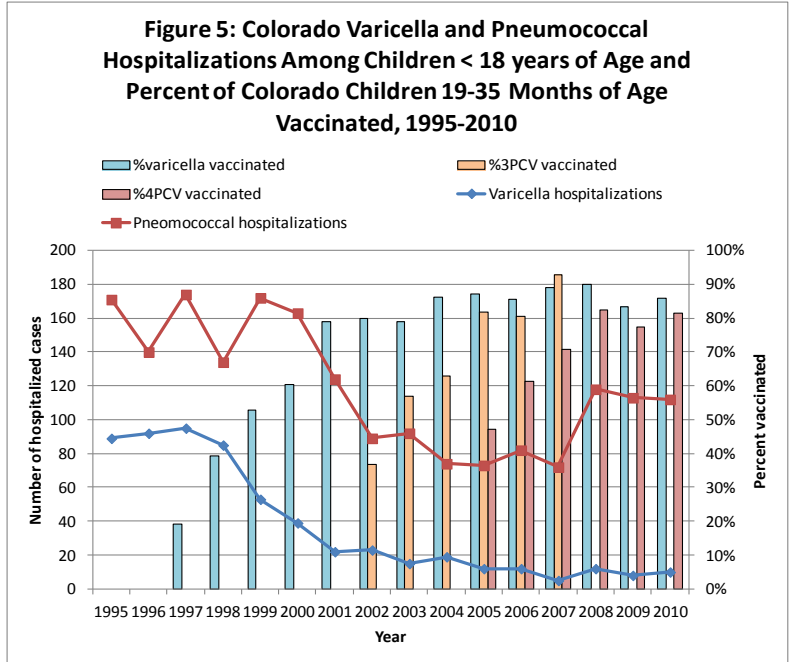
Hospitalization Rate Disparities Persist

Figure 4 shows that as Colorado's vaccination rank for the series 431331 has increased, Colorado rates of hospitalization for VPDs (not including influenza) have decreased somewhat. However, the rates of VPD are still higher and more volatile for Colorado children who have public or no health insurance coverage (red line) than those with private insurance coverage (blue line). In fact, although the gap appeared to be closing, the likelihood in 2010 of being hospitalized for a VPD is still over twice as high for children in Colorado with Medicaid/SCHIP or no insurance than for those with private insurance.



Vaccines Are Effective!

Previous editions of this report have documented the dramatic effect that the current vaccine schedule has had in reducing severe vaccine preventable diseases in Colorado. **Figure 5** additionally shows the clear impact of two recent additions to the vaccine regimen (varicella and pneumococcus) on a similar reduction of related hospitalization rates in Colorado. As varicella (chickenpox) vaccination increased in the late 90's, admissions to the hospital for its complications (many severe such as necrotizing fasciitis and encephalitis) decreased by 90%. As the pneumococcal vaccine rates increased, a similar reduction in hospitalization for severe pneumococcal disease (sepsis, meningitis) was seen, (followed by a more recent increase associated with non-vaccine strains that has resulted in the expansion of coverage of the pneumococcal vaccine from 7 to 13 strains). In the prior decade, a sustainable reduction of over 90% in *Haemophilus influenzae* sepsis and meningitis was similarly achieved by vaccination.



Delayed Vaccination Continues To Be a Risk for Colorado's Youngest Children

Some groups persist in advocating for delayed or alternative vaccination schedules without evidence that such practices are safe or effective. Delaying vaccination puts Colorado's most vulnerable infants and young children at risk for VPDs and their complications. **Figure 6** shows the age distribution of hospitalized VPDs in Colorado in 2010. Over three-fourths of the cases occur in children four years of age or younger. In addition, these diseases are commonly more severe in the youngest children as demonstrated with children with whooping cough (pertussis) and influenza.

Figure 6: VPD Hospitalizations of Colorado Children in 2010, Including Influenza and Rotavirus

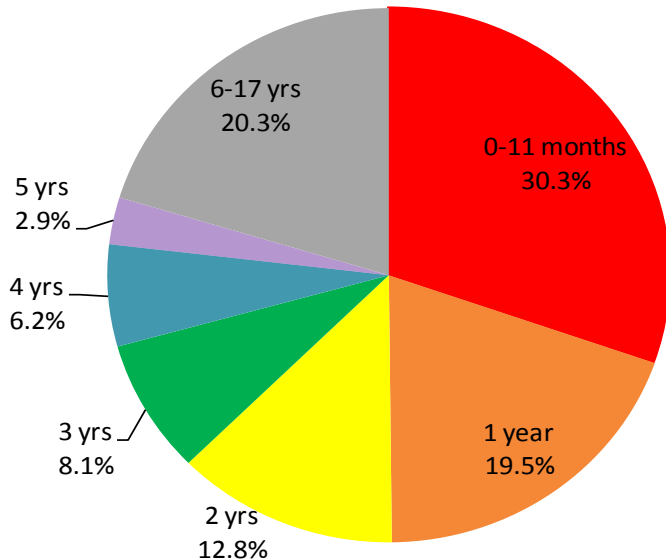


Figure 7 shows the number of hospitalized cases of various severe vaccine preventable diseases that potentially could be avoided with stricter adherence to assuring complete and timely vaccination of Colorado's youngest children

Continued efforts to vaccinate Colorado's youngest children in a timely fashion are critical as significant compliance gaps currently exist.

Figure 8 shows the compliance rates with recommended vaccine timing in Colorado in 2010 for the first 24 months of life. It shows waning degrees of compliance at the four and six month recommended doses and a slow compliance with initial doses of hepatitis B, varicella and MMR vaccines. Misinformation regarding the risk of vaccines as well as alternative schedules that have been recommended without appropriate testing of efficacy likely contribute to these immunization gaps. Although not measured currently by the NIS survey, it is likely that there is also a similar lack of compliance in these young children for the rotavirus and influenza vaccines as well.

Poor compliance with recommended influenza vaccination of young children in Colorado has been documented in a previous study, **Figure 9**. Colorado had lower influenza vaccination rates than other states (which were also quite low) in 2007-2008. Colorado's rate of vaccination was low despite a national strategy to reduce morbidity and mortality in this vulnerable age group by vaccinating younger children (now starting at 6 months of age). Although this vaccination rate has probably increased in Colorado, it is likely that many children remain unimmunized in the first several years of life. In the 2008-2009 influenza season, over one-third of all hospitalized influenza cases were children under 4 years of age resulting in 7 deaths (CDPHE)

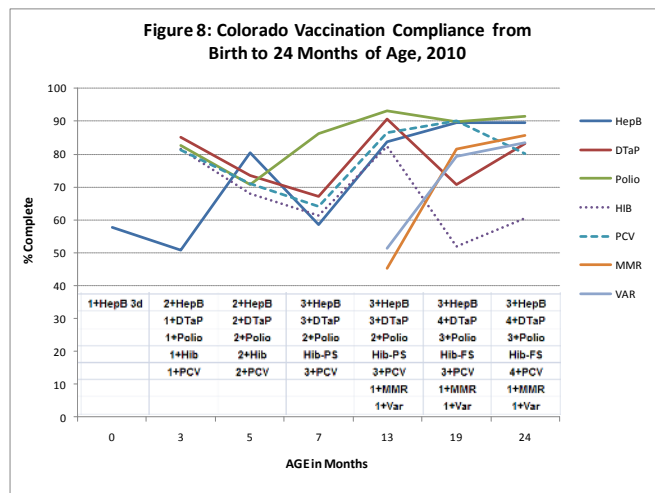
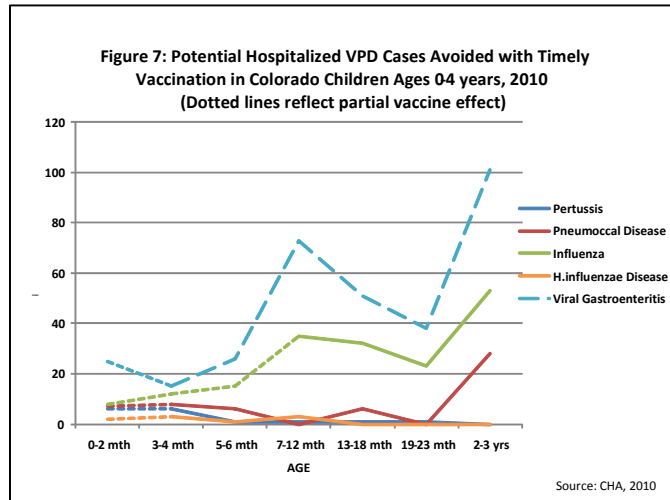
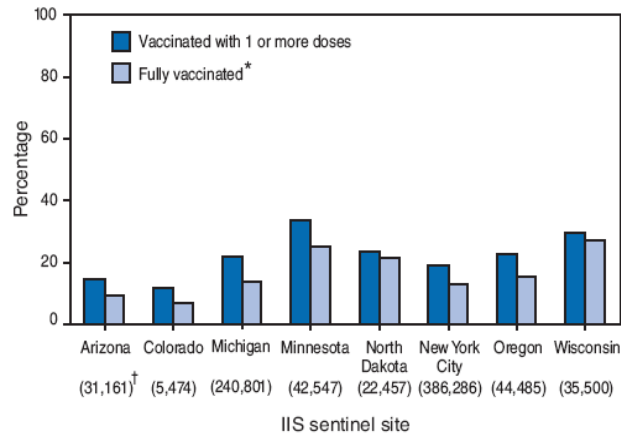


Figure 9: Percentage of children aged 24–59 months who received influenza vaccination — eight immunization information system (IIS) sentinel sites, United States, 2007–08 influenza season <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5738a3.htm>

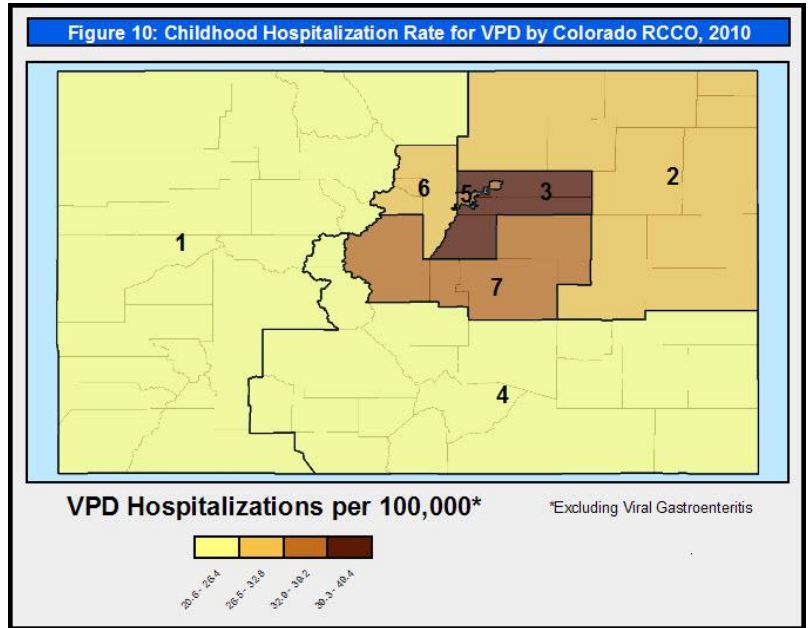


* Full vaccination = 1) receipt of 2 valid influenza vaccine doses in the current season among influenza vaccine naive children and children who received 1 dose for the first time during September 1, 2006–March 31, 2007, or 2) receipt of 1 vaccine dose in the current season among all other children.

[†] Number of children aged 24–59 months enrolled in the IIS at the sentinel site as of March 31, 2008.

Rates of vaccine-preventable disease may vary based on immunization rates and population density

As shown in **Figure 10**, childhood hospitalized vaccine-preventable disease rates vary by Colorado Regional Care Collaborative Organization (RCCO). These regions have been formed to coordinate regional care and focus on local solutions to improve that care. The 2010 map suggests that risk of VPD may depend in part on risk of exposure (i.e. population density). It is also plausible that regional differences in VPD may be related to variation in immunization rates, but the annual NIS Survey does not have enough granularity to measure regional vaccination rates. Better information about age-related vaccine rates at the regional level would allow further exploration of the possibility of more local solutions to VPD risk.



Besides the morbidity and mortality associated with vaccine-preventable diseases, delaying or not giving vaccines costs all Coloradans.

As shown in **Table 1** for pertussis, varicella, influenza, viral gastroenteritis, *Streptococcus pneumoniae*, and *Haemophilus influenzae*, there was \$27 million in hospital charges (\$16 million for those with public or no insurance) for severe disease associated with VPD in Colorado children in 2010. The table actually underestimates the potential costs, since it does not include those hospitalized children with respiratory disease that can be attributed to influenza, or children and adults with VPDs who are not admitted to the hospital.

Table 1: Cases and charges for children in Colorado with vaccine-preventable diseases, 2010.

Vaccine	CDPHE Reported Cases 0-19yrs	CHA Hospitalized 0-20 yrs	CHA Hospitalized Charges	CHA Hospitalized Public Cases	CHA Hospitalized Public Charges
Pertussis	394	18	\$519,980	11	\$284,804
Pneumococcal Disease*	86	117	\$7,417,415	62	\$4,083,375
Influenza	57	237	\$5,651,329	137	\$2,455,071
H.influenzae	25	9	\$1,232,232	4	\$390,561
Varicella	363	12	\$305,923	6	\$145,353
Viral Gastroenteritis	not reported	548	\$11,858,317	329	\$8,649,513
Total Charges			\$26,985,196		\$16,008,677

- **Comment**

There is clear evidence in Colorado of the safety and efficacy of vaccines in preventing many severe childhood illnesses and reducing health care costs. Although progress has been made in the past several years in improving vaccination rates, Colorado still has not met the national target of 90%, and still has significant childhood morbidity, mortality and social and economic cost related to vaccine-preventable diseases. The hospital-related charges for treating these vaccine-preventable diseases in children still runs in the tens of millions of dollars yearly, significantly impacting both the public and private sectors. There is evidence that vaccination rates may be influenced by economic circumstances and unsubstantiated theories advanced in the social media. There remains a disparity in vaccine-preventable disease rates in our youngest and poorest children. Regional differences exist.

System improvements are necessary to reduce the rate of VPDs in young children. Although school immunization regulations may improve vaccination rates, the greatest risk for many of these diseases is in young infants, emphasizing the critical need for a system to assure timely vaccination of our youngest children. Since many of the most effective vaccines must be given in the first year of childhood, an efficient early delivery system is essential.

In past studies, the strongest correlate of the incidence of VPD in Colorado counties with populations > 5,000 children < 18yrs of age is the percentage of children in families with incomes less than two times the Federal Poverty Level ($p=0.004$) [SHCC:VPD 2006]. According to the Colorado Children's Campaign, "Between 2000 and 2009, Colorado experienced the fastest growing number of children living in poverty in the nation. While the percentage of children in poverty remains below the national average it was still high at the beginning of the recession with 179,000 children, or 15 percent, living below the FPL. By 2009, the number rose dramatically to 210,000 children, or one of every six children in Colorado." http://www.coloradokids.org/facts/kids_count/

Increasing the number of these children enrolled in Medicaid and State Children's Health Insurance Plan (SCHIP) and implementing state-wide newborn enrollment, consolidation of vaccination information in one easily accessible record for each child and a recall program via the Colorado Immunization Information System (CIIS) could improve annual vaccination rates and simultaneously provide information to parents about the importance of (and access to) primary preventive care for their children as well as accurate rates for RCCO use. Systems to rapidly respond to mass vaccination campaigns for influenza should be designed--especially for children, who are the most vulnerable and the most likely to transmit it to others.

Although a few advocate against the use of vaccines, claiming their possible role in the causation of various adverse events including asthma, autism and other neurological conditions, rigorous reviews of evidence do not support these hypotheses. As an example, a recent, thorough review by the Institute of Medicine concluded that "the body of epidemiological evidence favors rejection of a causal relationship between thimerosal-containing vaccines [and/or MMR] and autism" (<http://www.nap.edu/catalog/10997.html>). Nonetheless, anti-vaccine proponents continue to advance unsubstantiated theories that misinform the public resulting in decreased vaccination rates and increased morbidity and mortality of vaccine-preventable diseases.

Current vaccination rates and success in reducing related diseases is no cause for complacency. It is often suggested that a vaccination rate of 80% is high enough to confer so-called "herd" or "community immunity" which limits spread of infection and protects the remaining, unvaccinated individuals from being exposed. However, this number is misleading for several reasons. Measles and whooping cough are highly contagious; for these the rate of vaccination for long-lasting community immunity is believed to be more than 90%. In addition, herd immunity is a phenomenon that is used to explain the spread of outbreaks of disease, not the risk of individual cases. It does not protect those who are not vaccinated from getting a disease if exposed by those visiting or returning from other countries where diseases that are rare in the US are more common. Many such outbreaks have been documented in the US in recent years. Most importantly, for many of the vaccine-preventable diseases (e.g. chicken-pox, pertussis, and pneumococcal infection), there is an ongoing risk of exposure from seemingly well individuals who still carry the organisms in the community.

Current evidence suggests that there are still significant gaps in vaccinating Colorado's children – especially the youngest ones - in spite of ample evidence in Colorado that these vaccines are safe and effective. Implementing systems that assure access to vaccines for all children, as well as timely vaccination, is critically important to children's health, especially during the first two years of life when young children are at the highest risk of VPDs.